

REMARKS

In the Office Action mailed on August 17, 2009, the Examiner rejected claims 1-6, 12, 1-19, 23, 24, 36, and 37 under 35 U.S.C. §112, ¶2, as indefinite for lacking antecedent basis in claim 1 for a term used therein. We respectfully submit that the foregoing amendment fully addresses the rejections under §112.

The Examiner rejected claims 1-6, 21, 24, 25, 32-34, and 36 under 35 U.S.C. §103(a) as unpatentable over WO 00/17102 in view of U.S. Patent No. 6,855,376 to Hwang et al. (“Hwang”); claims 1, 2, 12, 15, 18, 19, 24, 25, 29-34, 36, and 37 under §103(a) as unpatentable over U.S. Patent No. 6,413,487 to Resasco et al. (“Resasco”) in view of Hwang; claims 4-6, 16, 17, 21, and 24-26 under §103(a) over Resasco in view of Hwang and further in view of U.S. Patent No. 6,967,013 to Someya et al. (“Someya”); and claims 21-29 under §103(a) over Resasco in view of Hwang and further in view of U.S. Patent No. 4,572,813 to Arakawa (“Arakawa”).

In this response, we have amended claim 1 to include the limitations of dependent claims 18 and 19 (in relation to substrate particles), and have canceled these dependent claims. Additional support for this amendment is found at least on page 5, lines 19-29 of the specification as published at the PCT stage.

The present invention, as claimed herein, is directed to a method of producing aligned carbon nanostructures. The method involves providing finely divided substrate particles with radii of curvature of more than 1 μm and length and breadth of between 1 μm and 5 mm and having catalyst material on their surface. A carbon-containing gas is also provided, at a temperature and pressure at which it reacts to form carbon in the presence of the catalyst, with the carbon forming reaction forming aligned carbon nanostructures. The substrate is freshly prepared by colloidal processing, spray drying, hydrothermal processing, or ball milling. The catalyst material is deposited on the surface of the substrate particles using any of the specified methods and the catalyst material is iron, cobalt, molybdenum or nickel, or an alloy thereof. As is mentioned in the present application at page 5, lines 22 to 25, the inventors have advantageously determined that substrate material freshly prepared according to the method of the invention provides best results.

Resasco provides a process for continuous catalytic production of carbon nanotubes. The catalytic particles comprise a solid support material impregnated with a metallic catalyst and calcined and processed into a pellet form, with processing into the pellet form occurring before or after impregnation of the support material with the catalyst. Resasco's disclosure does not make any mention of what dimensions these pellets should have or how the support material is formed into pellets. The reference does, however, indicate in embodiments that the support material is subject to dissolution by treatment with a base or an acid (column 4, lines 45-54) and is then recovered by precipitation (column 5, lines 14-16) and formed into pellets after being impregnated with catalyst using methods well known in the art (column 5, lines 28-30). The pellets obtained by such a process would be expected to be formed from pelletized powder of the solid support impregnated with the metallic catalyst throughout the pellet. There is nothing in Resasco that would result in the skilled person forming the substrate particles by colloidal processing, spray-drying, hydrothermal processing or ball milling, then depositing catalyst material on the surface of the substrate particles.

In rejecting former claims 18 and 19, the Examiner refers to col. 2 (apparently intending to cite col. 3), lines 33-45. Nothing in the cited passage specifically, or in Resasco generally, is even remotely relevant to the manner in which the substrate particles are prepared, much less their preparation as recited in these former claims (whose limitations now appear in claim 1).

More generally, as has been pointed out previously, nothing in Resasco would encourage the skilled person to seek any other type of catalytic particle, much less one with a substantially smooth surface with radii of curvature and dimensions as specified in the present claims with catalyst material on the surface. Resasco also does not teach methods for production of aligned nanotubes, and therefore the skilled person looking to produce aligned nanotubes, in accordance with the present claims, would not consider Resasco.

Indeed, not only is Resasco unrelated to the present claims, but actually teaches away from the present invention: whereas Resasco expressly contemplates catalyst throughout the pellet, claim 1 requires catalyst material to be deposited onto the surface of already-formed substrate particles by the deposition methods recited in the claim. As set forth in the MPEP, "It is improper to combine references where the references teach away from their combination."

MPEP § 2145(X)(D)(2) (emphasis added), citing *In re Grasselli*, 713 F.2d 731, 743, 218 USPQ 769, 779 (Fed. Cir. 1983). Claim 1 is thus inventive over Resasco, as are all of the other claims, which depend on claim 1.

The Examiner cites various combinations of Resasco with Hwang, Someya and Arakawa against the present claims. The skilled person would not combine any these three references with Resasco, and furthermore, even if the proposed combinations were proper, there is nothing in any of these references that relates to substrate particles prepared by colloidal processing, spray-drying, hydrothermal processing or ball milling. Thus, the secondary references do not fulfill the deficiencies of Resasco with regard to claim 1 which, along with the dependent claims, is inventive over the combination of the prior art.

It follows from the above analysis that the subject matter of the present claims is patentable over the cited art. The use of the claimed methods to produce aligned carbon nanostructures represents an empirical finding that could not be predicted prior to the priority date of the present application. The invention as delimited by the claims is accordingly inventive.

CONCLUSION

It follows from the above analysis that the references of record, considered independently or in proper combination, do not render unpatentable the subject matter of the present claims. Accordingly, we respectfully request reconsideration and withdrawal of the examiner's objections.

Please charge any additional fee occasioned by this paper to our Deposit Account No. 07-1700.

Respectfully submitted,

Date: December 17, 2009
Reg. No. 33,497

Tel. No.: (617) 570-1241
Fax No.: (617) 523-1231

By: /Steven J. Frank/
Steven J. Frank
Attorney for Applicants
Goodwin Procter LLP
Exchange Place
Boston, Massachusetts 02109